OBSERVATIONS ON THE PRAWN FISHERY OF THE MANGALORE ESTUARY ON THE SOUTH-WEST COAST OF INDIA

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ABSTRACT

The estimated annual prawn landing varied from 1.09 to 5.54 tonnes, the peak period of the fishery being November-February. The fishery showed an inverse relationship to rainfall in all the years except in 1965-66.

The catch was mainly composed of *Metapenaeus dobsoni, Penaeus indicus* and *M. monoceros* in the order of their abundance. The modal size for *M. dobsoni*, exclusively caught by shore-seine, ranged from 31 to 40 mm. Differences were noticed in the size composition of *P. indicus* caught by different gears which were apparently related to the areas of operation. χ^2 analysis showed significant variations in the sex ratio of the juveniles of *M. dobsoni* especially during the latter part of the season. It has been pointed out that this is also likely to be a factor of influence on the pattern of sex distribution of adult sizes in the sea.

INTRODUCTION

It is well known that most of the commercial species of penaeid prawns caught from the sea constitute a fishery in the estuary early in their life, a knowledge of which, therefore, is a prerequisite for the marine fishery research. The earlier accounts relating to the prawn fishery of the estuary on the west coast of India are restricted chiefly to the backwaters of Kerala (Gopinath, 1955; Panikkar and Menon, 1955; Menon,1955; Menon and Raman, 1961 and George, 1962). Although at Mangalore 750 m.tons[1] of prawns are landed constituting about 33.1% of the total annual catch by the mechanised boats which generally trawl in the coastal belt between 10 miles north and south of Mangalore, no information is available on the prawn fishery of the estuarine region of the several hill streams flowing down in this area. Therefore a study of the prawn fishery in the estuary at Mangalore was undertaken to assess the magnitude of the fishery, catch composition, seasonal trends and size composition of important species. In addition, the data pertaining to sex ratio of

1. Average of the landings from July 1962 to June 1968, through the courtesy of the Directorate of Fisheries, Mysore.

the chief commercial species, *Metapenaeus dobsoni*, have been statistically dealt with herein, to find out whether there are any significant variations as these may throw some light on the wide disparities in the sex distribution of this species commonly noticed in the marine fishery.

Material and Methods

The estuary at Mangalore, locally known as the Mangalore estuary, is formed by the confluence of the river Netravati in the south and the river Gurpur in the north. Fishing is usually carried out at three or four centres within a distance of one km. from the river mouth. For the present study, an important centre near Bengre, located on the Gurpur river, was chosen. Here, shore-seines (*Kairampani*) are operated almost throughout the year in depths of 1-4 metres. This net consists of 10-15 pieces each measuring 4.5-6 m in length and 3.5-4.5 m in height with a mesh size ranging from 1.5 cm at the centre to 2.5 cm at the end piece. Cast nets 3.5-5.5 m in radius with a mesh size of 1.5 to 2.0 cm are also operated but only seasonally during December-March in depths of 3 to 6 m. Fishing is carried out mostly between 5 and 10 A.M.

Weekly data were collected from July 1963 to June 1968 for estimating prawn production. Random samples of the catch were sorted out species-wise and their weights and total lengths[2] of males and females separately recorded.

Fishery

The estimated landing of prawns at Bengre during the years 1963-64 to 1967-68 was 1.43, 2.47, 4.25, 5.54 and 1.09 m.tons respectively. The month-wise landing of prawns is represented in Fig. 1. Cast nets accounted for 600 kg in February 1965, 1200 kg in December 1965, 100 kg in January 1966, 30 kg in March 1967 and 108 kg in January 1968 while the rest of the catch as well as that in all the other months were by the shore-seines. The peak period of the fishery was during November-February.

The catch variations in the shore-seines in the different months did not show any significant relation to the phases of the lunar period. The highest catch, however, was recorded in the darker phase, in the course of this study. In the case of cast nets, the trend of the catch was different, being distinctly high in the brighter phases of the moon. This is perhaps related to the differences in the species caught by these gears, as will be seen later.

The available data on the annual landings and the rainfall[3] appear to show certain relationship. Since more than 80% of the annual rainfall was during

2. Length from the tip of the rostrum to the tip of the telson.

3. Through the courtesy of the Indian Meterological Department.

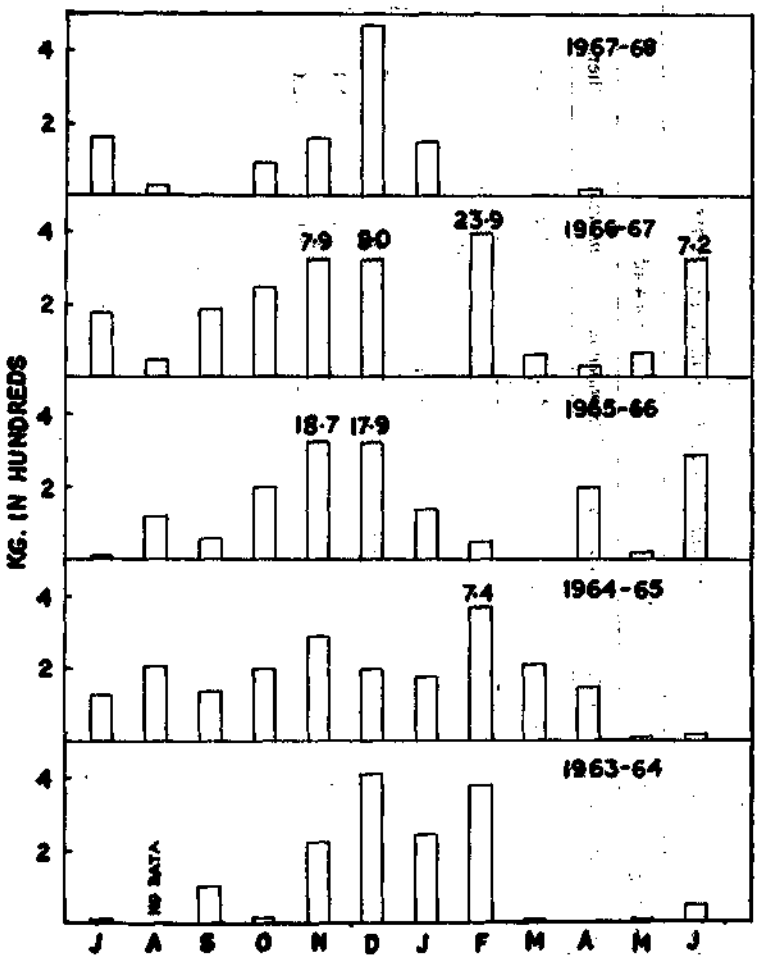

Fig. 1. Monthly prawn landings in the different years.

June-October, the rainfall during that period is taken into account for comparison. It may be noted that the prawn fishery improved to reach its height only during the subsequent months. The rainfall during 1963-67 was 2877, 2494, 2561, 2372 and 3198 mm respectively.

Catch composition and seasonal variations

The yearly catch composition by weight for the two gears separately and for both together is represented in Table 1. *M. dobsoni* dominated the catches, being caught exclusively by the shore-seines, *Penaeus indicus* ranked second

TABLE 1. *Gearwise percentage catch composition of prawns by weight in different years*

Gear	1963–64				1964–65			
	M. dobsoni	*M. monoceros*	*P. indicus*	Others*	*M. dobsoni*	*M. monoceros*	*P. indicus*	Others
All gears	—	—	—	—	47.1	9.2	41.3	2.4
Shore-seine	57.2	3.6	38.0	1.2	62.7	12.2	22.0	3.1
Cast nets		Not operated			—	—	100.0	—
		1965-66				1966-67		
All gears	49.8	3.6	45.5	1.1	72.3	3.3	5.7	18.7
Shore-seine	70.9	5.1	22.4	1.6	72.7	3.3	5.2	18.8
Cast nets	—	—	—	100.0	—	—	88.0	12.0
		1967-68						
All gears	65.7	14.6	14.6	5.1				
Shore-seine	72.8	16.2	6.0	5.0				
Cast nets	—	—	92.6	7.4				

* "Others": *P. monodon, P. semisulcatus, M. affinis, Acetes* sp. and non-penaeid prawns.

in abundance. Numerically also *M. dobsoni* predominated as one kg of this species contained 1000-8000 individuals while for *P. indicus* it was 150-1000 individuals per kg. *M. monoceros* was next in abundance by weight.

Occasionally, as in June 1967, *Acetes* sp. was caught in good quantities. *M. affinis, P. monodon, P. semisulcatus, M. burkenroadi* and non-penaeid prawns were also noticed to occur in the shore-seine catch. Cast net catches were chiefly composed of *P. indicus*. *P. semisulcatus* occurred in few numbers.

Since *M. dobsoni* and *P. indicus* were the chief species in the catch, their monthly variations in different years are shown in Fig. 2. As the percentage

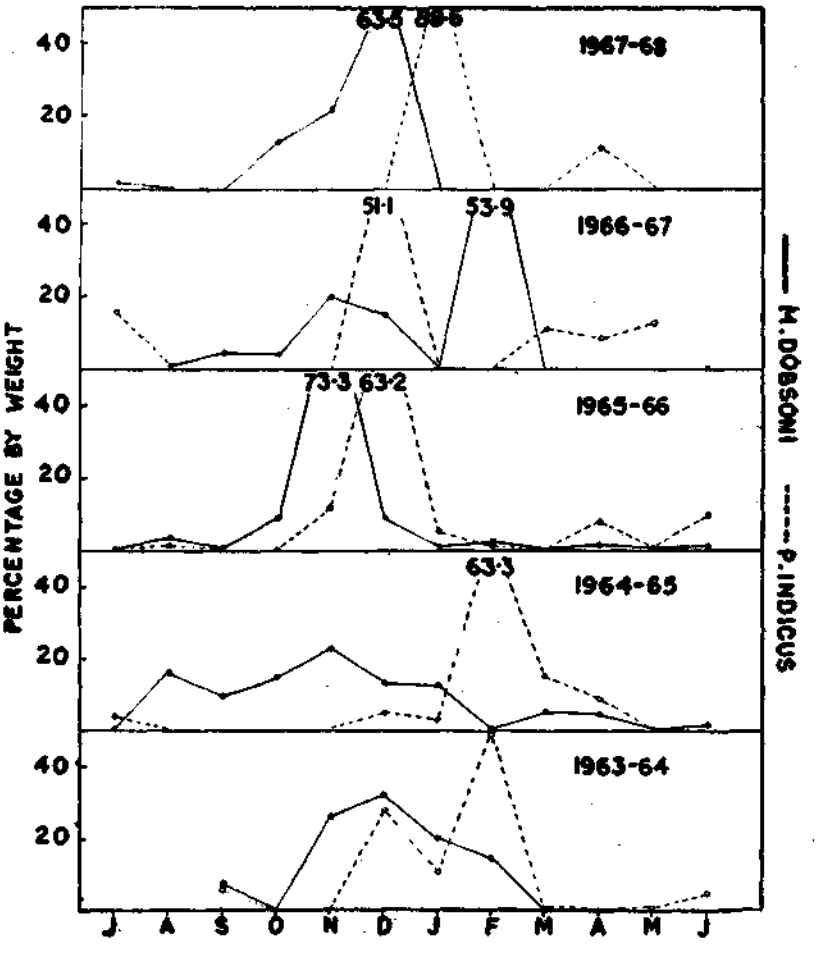

Fig. 2. Monthly variations in the catches of *M. dobsoni* and *P. indicus* in the different years.

composition of the species in the monthly catches will not give a picture of the trend of their variations quantitatively, the monthly percentage with reference to the annual landings of these species is given. While the peak of occurrence for *M. dobsoni* was protracted during 1963-64, 1964-65, 1966-67 and 1967-68 it was restricted to a single pronounced peak in November during 1965-66. As for *P. indicus*, the peak was in February during 1963-64 and

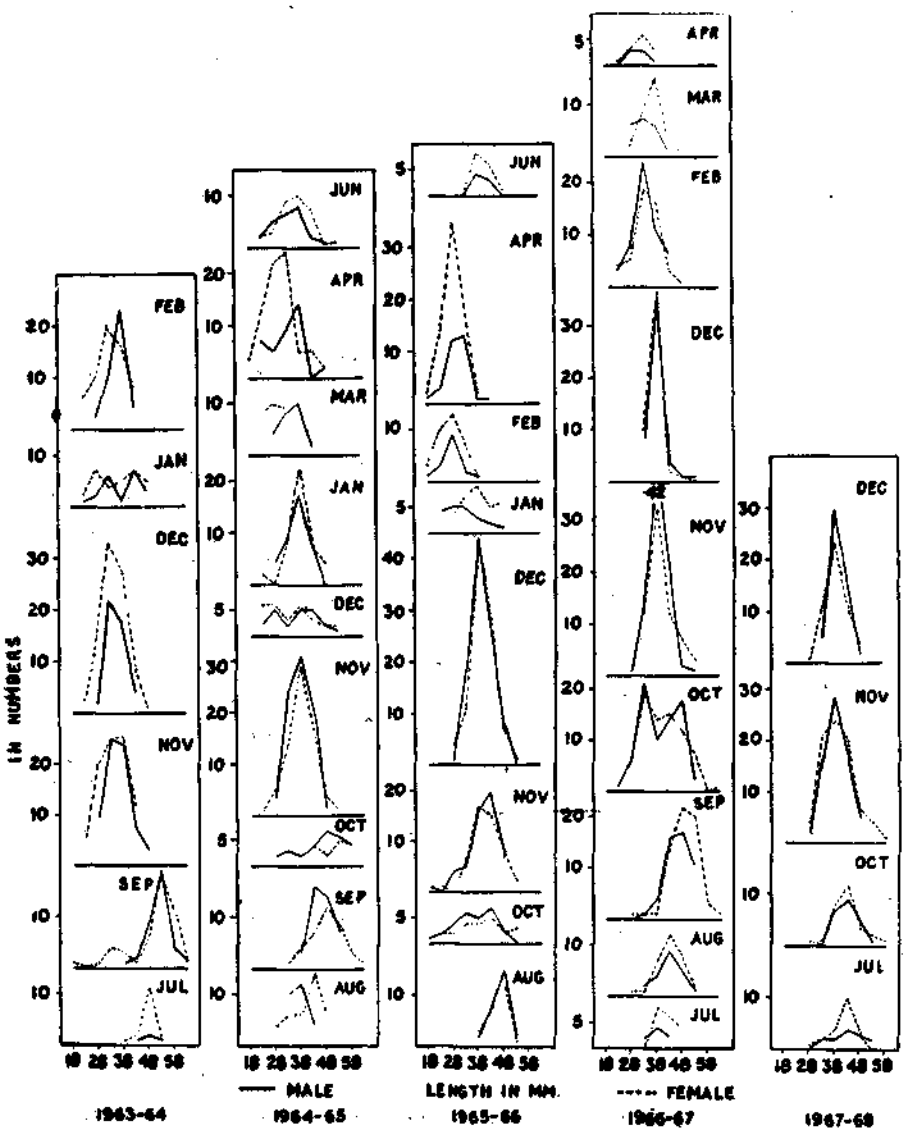

Fig. 3. Monthly length frequency of *M. dobsoni* during 1963-67.

1964-65, in December in the following two years and in January during 1967-68. Thus it was seen that its peak occurred following that of *M. dobsoni* except in 1966-67. During 1966-67 also, the peak for *P. indicus* was preceded by a secondary peak for *M. dobsoni*. *M. monoceros* occurred mainly during June-November.

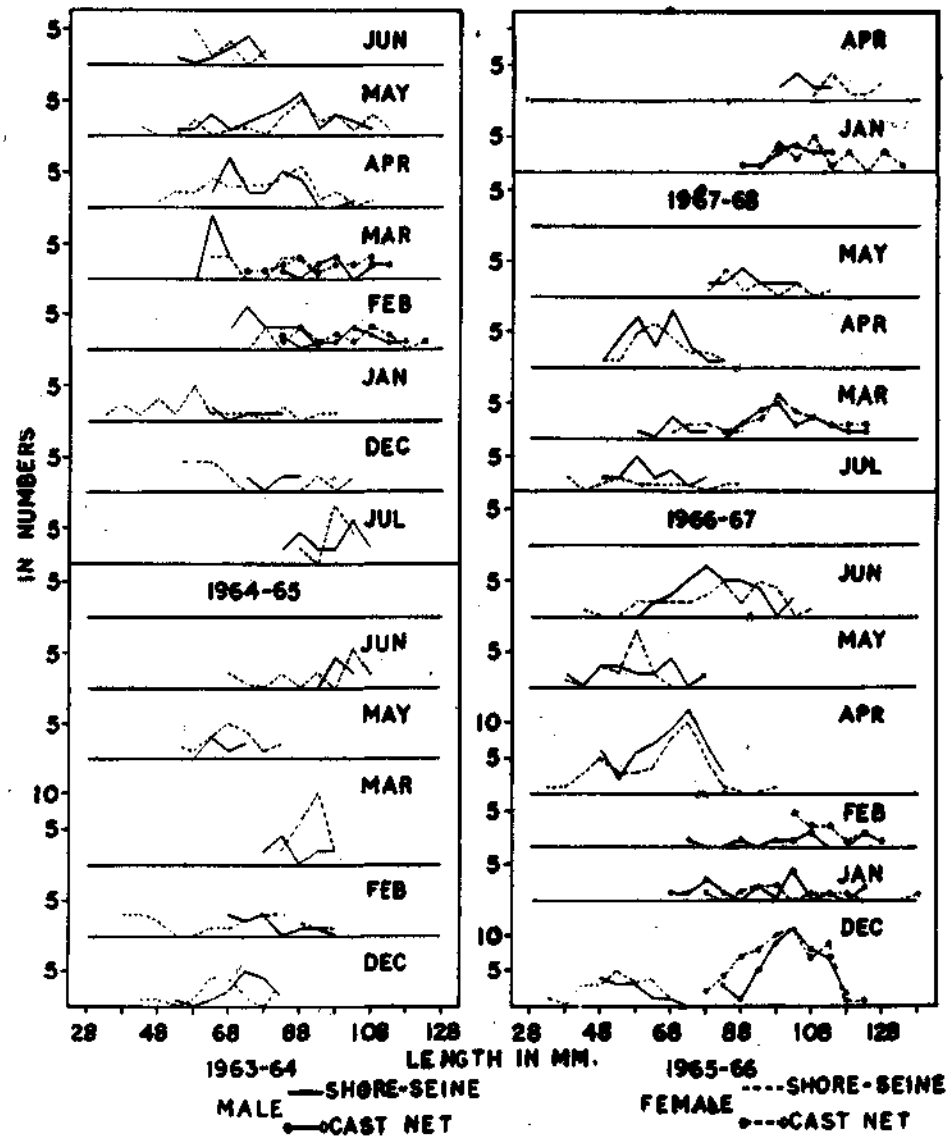

Fig. 4. Monthly length frequency of *P. indicus*, during 1963-68.

SIZE-GROUPS

Monthly length frequencies in respect of *M. dobsoni* and *P. indicus* are shown in Fig. 3 and 4 respectively. Insufficient numbers or absence of prawns in the samples account for the omission of certain months in the length frequency curves.

M. dobsoni — Specimens measuring over 60 mm were extremely rare, the largest male and female recorded being 59 mm and 62 mm respectively. The modal positions varied from 31-35 to 51-55 mm for males and 26-30 to 51-55 mm for females during 1963-64. It was from 26-30 to 46-50 mm for both sexes in the following two years, from 31-35 to 46-50 mm for both sexes during 1966-67 and from 36-40 to 41-45 mm for males and 31-35 to 41-45 mm for females during 1967-68. Among these groups, 31-40 mm group predominated for most of the months particularly during the peak period of the fishery from November to February.

P. indicus — While the cast net catch consisted of larger size groups, those in the shore-seines were generally smaller in size though in some months larger size groups (e.g., in June-July 1964, April-May 1965, June 1966 and May 1967 specimens measuring over 105 mm were caught) occurred in small numbers. Specimens measuring over 100 mm were rare in the shore-seines (the largest male and female being 115 and 129 mm respectively). In the cast net, those measuring over 125 mm (largest male and female being 130 and 136 mm respectively) were rare.

The size frequency curves for *P. indicus* are not complete owing to lack of material. However, it may be seen from Fig. 4 that in the shore-seines the modal sizes fluctuated between 71-75 to 96-100 mm for males and 61-65 to 101-105 mm for females during 1963-64. The larger modal sizes noticed in June continued to occur in July of 1964-65. During December-April smaller sizes with modes at 61-65 to 81-85 mm for males and 61-65 to 86-90 mm for females were recorded. In the succeeding year the modal sizes for males and females ranged from 46-50 to 76-80 mm and 51-55 to 81-85 mm respectively. During 1966-67 the males and females had the modes between 56-60 and 86-90 mm and 51-55 and 51-55 and 81-85 mm respectively. In the next year, the occurrence of *P. indicus* in fair numbers was restricted to April 1968 when larger size groups, viz., 101-105 mm for males and 111-115 mm for females were dominant. In the cast nets, size groups of 96-100 mm and above predominated for both sexes throughout. Differential growth in the sexes seems to be apparent in size groups of over 100 mm as the modal sizes for females were found to be larger than males from then on.

M. monoceros — This species occurred only in the shore-seine catches. Details of length frequencies are not dealt with since its occurrence was comparatively negligible. The modal sizes recorded for either sex fluctuated bet-

TABLE 2. *The sex ratio of* M. dobsoni *in different months during 1963–64 to 1967–68*

Months	1963–64			1964–65			1965–66			1966–67			1967–68		
	Sample size	Males	Ratio	Sample size	Males	Ratio	Sample size	Males	Ratio	Sample size	Males	Ratio	Sample size	Males	Ratio
July	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
August	—	—	—	124	60	0.48	100	52	0.52	100	42	0.47	—	—	—
September	158	72	0.46	152	80	0.53	—	—	—	200	94	0.47	—	—	—
October	—	—	—	100	56	0.56	100	54	0.54	294	144	0.49	100	46	0.46
November	292	136	0.47	300	160	0.53	204	106	0.52	300	168	0.56	300	140	0.47
December	264	90	0.34	100	44	0.44	244	127	0.52	200	98	0.49	200	102	0.51
January	150	60	0.40	160	74	0.46	100	40	0.40	—	—	—	—	—	—
February	98	40	0.41	—	—	—	100	32	0.32	200	104	0.52	—	—	—
March	—	—	—	100	44	0.44	—	—	—	100	40	0.40	—	—	—
April	—	—	—	200	68	0.34	97	31	0.32	60	21	0.35	—	—	—
May	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
June	—	—	—	100	40	0.40	—	—	—	—	—	—	—	—	—
Total	962	398	0.41	1336	626	0.47	945	442	0.47	1454	711	0.49	600	288	0.48

ween 41-45 to 71-75 mm. Specimens over 80 mm were rare, the largest male and female being 90 and 104 mm respectively.

Sex Ratio

Monthly sex ratios in respect of *M. dobsoni* during July 1962-June 1968 are presented in Table 2. These are tested for distribution of equality in sexes using χ^2 formula (Cochran, 1954).

$$\chi^2 = \frac{\sum \left(\frac{x_i^2}{n_i}\right) - \frac{(\sum x_i)^2}{\sum n_i}}{pq}$$

where

x_i = number of males

n_i sample size

$$p = \frac{\sum x_i}{\sum n_i}$$

and $q = 1 - p$

The values or χ^2 and the relevant details for the various years are given in Table 3. It is evident that the values of $p > 0.05$ during 1964-65 and 1965-66, thereby indicating equal distribution of both the sexes in the samples. Slight variations in the values of sex ratio may be attributed to the sampling fluctuations. In the other years $p < 0.05$ from which it may be concluded that the theory of equal distribution of sexes does not hold good. However, it may be stated that observations during 1967-68 were necessarily limited on account of the brief nature of the fishery.

TABLE 3. χ^2 *values for sex ratio*

Year	*D.F.*	*Value*	*Probability of p.*
1963-64	4	10.29	$0.05 < p < 0.02$
1964-65	8	26.43	> 0.05
1965-66	6	27.27	> 0.05
1966-67	7	16.80	$0.02 < p < 0.01$
1967-68	2	1.08	$0.70 < p < 0.50$

Though it is inconclusive whether there is an equal distribution of both the sexes on the season-wise basis, further analysis of the monthly data, however, show that there is a real fluctuation within the season. During 1963-64, the proportion of males was low in all the months (Table 2), a decline in the proportion being however discernible after November. A non-significant χ^2 value 0.04 for 1 D.F. for the period September-November and a significant χ^2 value 10.08 for 2 D.F. for the period September-December were estimated during 1963-64. In the succeeding two years males were predominant in the earlier part of the season, a change in the sex ratio occurring in December during 1964-65 and in January during the next year. For the period August-March a non-significant χ^2 value of 7.12 for 6 D.F. and for the period August-April a significant χ^2 value of 24.38 for 7 D.F. were obtained during 1964-65. Similarly in the next year (1965-66), for the period August-January a non-significant χ^2 value of 5.39 for 4 D.F. and for the period August-February a significant χ^2 value of 17.68 for 5 D.F. were calculated. During 1966-67, though a decline in the proportion of males was noticeable from March, the χ^2 values of 8.08 for 5 D.F. for the period August-February and 12.60 for 6 D.F. for the period August-March were not significant, since unlike in the previous two seasons, females predominated in the earlier part of the season. During 1967-68 such changes in the sex ratio or decline in the sex proportions could not be witnessed since the fishery was of a short duration. So it can be stated in general that the latter months are the ones that affect the sex ratio due to the predominance of females. This also perhaps shows that females stay longer in the estuarine habitat.

General Remarks

The role of rainfall as a possible factor in determining the prawn yield has been emphasised at a meeting of the Indo-Pacific Fisheries Council (1955). Hildebrand and Gunter (1953) did not observe any year-wise direct relationship between the catch of *Penaeus setiferus* and the amount of rainfall in Texas but pointed out the existence of such a relationship between the fishery and the rainfall of the preceding year. A similar relationship was noticed by Subrahmanyan (1964) in the case of *P. monodon* in the Godavary estuary, though his data also reveal an inverse relation between these parameters of the same year. Menon & Raman (1961) reported a direct relationship between rainfall and the prawn catch of the same year in the Cochin backwaters but their observation was limited to only two years. From the present data it is apparent that the fishery is mainly constituted by *M. dobsoni* of the early '0' year class. Therefore, for purposes of this investigation the rainfall and the prawn catch of the same year have been taken into account. Except in 1965-66, an inverse relationship was observed throughout. The existence of such inverse relationship can be attributed to the intensity of river discharge in direct relation to the amount of rainfall. An increased flow of the river is likely to affect

adversely the abundance of juveniles in the nursery area. Racek (1959) observed that heavy rainfall causing extensive river floods resulted in the mass migration of prawns from the estuary into the sea in Eastern Australia. During 1965-66, the rainfall at Mangalore was higher than in the preceding year, whereas an almost two-fold increase in the catch could be noticed. Other factors, viz., environmental conditions and the fluctuations in the larval recruitment, may also be exerting certain influence on the magnitude of the fishery.

It was seen that the shore-seine caught all the species of prawns, while the cast net having more or less similar mesh and operated in the same months caught almost exclusively *P. indicus*. This may be due to the operation of these gears in areas of different depths, cast nets being in the deeper waters of 3-6 m. The size-groups of *P. indicus* occurring in the cast nets were also comparatively larger, which is perhaps due to their preference to the deeper regions of the estuary. George (1962) had also noticed, in the Cochin backwaters differences in the size-groups in the different types of nets which have been attributed to the mode of operation of the nets and the behaviour of the species. The size groups for *M. dobsoni* at Bengre are smaller when compared to those recorded by Menon and Raman (1961) in the Cochin backwaters which is probably related to the differences in the range in the mesh sizes of the gears used.

The variations in the sex ratio of *M. dobsoni* in the estuarine environment are of particular interest in the light of the observations on the sex distribution of this species from the sea. Menon (1957) observed that a good percentage of the females in the larger size-groups move out of the fishing grounds and reappear later thus resulting in the disparity of sex ratio. George and Rao (1967) found that there were more males in the trawl catches during June and November-December than during January-May. This was attributed by them to the breeding migration of females. The present investigations indicate that there were more males during August-November/December in the nursery grounds than in the subsequent period (January to April) thus revealing a similar pattern of distribution of the sexes in the marine environment. Based on the estimated growth rate of *M. dobsoni* (Banerjee and George 1967), it is seen that the fishery in the estuary is supported by 2-4 months old (26-50 mm) individuals whereas the marine fishery is constituted throughout by 4-10 months old (46-85 mm) groups. The older groups, i.e., (91-105 mm of 12-15 months old) dominate the fishery only during August-December. The size composition of the fishery of the estuary and sea indicate differences due to the migratory habits of the species. Still there appears to be some similarity in the pattern of distribution of the sexes. As stated earlier, the females of *M. dobsoni* show a tendency to stay longer in the estuarine habitat thus leading to their preponderance during the latter part of the season. It is, therefore, likely that the sex oriented migration of juveniles from the nursery grounds may also

be a factor of influence on the sex variations of the species in the marine environment.

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REFERENCES

ANONYMOUS. 1955. Report on the prawn symposium. *Proc. Indo-Pacific Fish. Coun.*, 6,(III):323-324.

BANERJI, S. K. AND M. J. GEORGE. 1967. Size distribution and growth of *Metapenaeus dobsoni* (Miers) and their effect on the trawler catches off Kerala. *Proc. Symp. on Crustacea, Mar. biol. Ass. India*, Part II:634-648.

COCHRAN, W. G. 1954. Some method for strengthening the common χ^2 tests. *Biometrics*, **10**:417-451.

GEORGE, M. J. 1962. Observations on the size groups of *Penaeus indicus* (Milne Edwards) in the commercial catches of different nets from the backwaters of Cochin. *Indian J. Fish.*, **9**:468-475.

GEORGE, M. J. AND P. VEDAVYASA RAO. 1967. Distribution of sex ratios of penaeid prawns in the trawl fishery of Cochin. *Proc. Symp. on Crustacea, Mar. biol. Ass. India* Part II:698-700.

GOPINATH, K. 1955. Prawn culture in the rice fields of Travancore-Cochin, India. *Proc. Indo-Pacific Fish. Coun.*, **6**, (II & III):419-424.

HILDEBRAND, H. H. AND G. GUNTER. 1953. Correlation of rainfall with the Texas catch of white shrimp *Penaeus setiferus* (Linnaeus). *Trans. Amer. Fish. Soc.*, **82**:151-155.

MENON, M. K. 1951. The life history and bionomics of an Indian penaeid prawn *Metapenaeus dobsoni* Miers. *Proc. Indo-Pacific Fish. Coun.*, 3(II): 80-93.

MENON, M. K. 1955. Notes on the bionomics and fishery of the prawn *Metapenaeus dobsoni* Miers on the south-west coast of India. *Indian J. Fish.*, **2**:41-56.

MENON, M. K. 1957. Contribution to the biology of penaeid prawns of the south-west coast of India, I. Sex ratio and movements. *Indian J. Fish.*, **4**:62-74.

MENON, M. K. AND K. RAMAN. 1961. Observations on the prawn fishery of the Cochin backwaters with special reference to stake net catches. *Indian J. Fish.*, **8**:123.

PANIKKAR, N. K. AND M. K. MENON. 1955. Prawn fisheries of India. *Proc. Indo-Pacific Fish. Coun.*, 6, (II & III):328-346.

RACEK, A. A. 1959. Prawn investigations in Eastern Australia. *State Fisheries Newsouthwales Res. Bull.*, **6**:5-57.

SUBRAHMANYAN, M. 1964. Fluctuations in prawn landing in the Godavari estuarine system. *Proc. Indo-Pacific Fish. Coun.*, **11**, (II):44-51.